WHAT IS CLAIMED IS:

1. An apparatus for preparing a specimen for microscopy, comprising:

a plasma generator for plasma cleaning said specimen; and

means for coating said specimen with a conductive material;

wherein said plasma cleaning of said specimen and said coating of said specimen may be performed under continuous vacuum conditions.

2. An apparatus according to claim 1, further comprising means for removing material from said specimen under said continuous vacuum conditions.

3. An apparatus according to claim 2, wherein said means for removing comprises means for etching said specimen using an ion beam.

4. An apparatus according to claim 3, wherein said means for etching comprises an ion source for directing said ion beam at said specimen.

5. An apparatus according to claim 4, wherein said means for etching further comprises a source of process gas positioned adjacent said ion source.

6. An apparatus according to claim 1, said means for coating comprising a magnetron sputtering device.

7. An apparatus according to claim 1, said means for coating comprising an ion source for directing an ion beam at a target, said target being formed of said conductive material.

8. An apparatus according to claim 1, further comprising a first chamber and a second chamber, said first chamber being connected to said second chamber through a vacuum valve, wherein an inside of said first chamber may be exposed to an inside of said second chamber under continuous vacuum conditions by opening said vacuum valve.

9. An apparatus according to claim 8, said plasma generator being supported by said first chamber, said plasma cleaning of said specimen being performed inside said first chamber, and said means for coating being supported by said second chamber, said coating of said specimen being performed inside said second chamber.

10. An apparatus according to claim 8, further comprising a transfer rod for supporting said specimen and transferring said specimen between said first chamber and said second chamber under said continuous vacuum conditions.

11. An apparatus according to claim 2, further comprising a first chamber and a second chamber, said first chamber being connected to said second chamber through a vacuum valve, wherein an inside of said first chamber may be exposed to an inside of said second chamber under continuous vacuum conditions by opening said vacuum valve.

12. An apparatus according to claim 11, said plasma generator being supported by said first chamber, said plasma cleaning of said specimen being performed inside said first chamber, and said means for coating and said means for removing being supported by said second chamber, said coating of said specimen and said removing of said material from said specimen being performed inside said second chamber.

13. An apparatus according to claim 11, further comprising a transfer rod for supporting said specimen and transferring said specimen between said first chamber and said second chamber under continuous vacuum conditions.

14. An apparatus according to claim 1, further comprising a vacuum chamber, said vacuum chamber supporting said plasma generator and said means for coating, said plasma cleaning of said specimen and said coating of said specimen being performed inside said vacuum chamber.

15. An apparatus according to claim 2, further comprising a vacuum chamber, said vacuum chamber supporting said plasma generator, said mean for coating, and said means for removing, said plasma cleaning of said specimen, said coating of said specimen and said removing of said material from said specimen being performed inside said vacuum chamber.

16. An apparatus according to claim 1, wherein said plasma generator comprises a plasma tube, a coil wrapped around said plasma tube, and an RF power supply connected to said

coil.

17. An apparatus according to claim 16, further comprising a source of process gas including oxygen connected to said plasma tube, said plasma cleaning being performed using said process gas.

18. An apparatus according to claim 17, said process gas further including argon.

19. An apparatus according to claim 18, said process gas comprising a mixture of 75% argon and 25% oxygen.

20. An apparatus according to claim 17, said process gas further including a non-reactive gas.

21. An apparatus according to claim 8, further comprising a first vacuum pump connected to said first chamber for evacuating said first chamber to a first selected vacuum level and a second vacuum pump connected to said second chamber for evacuating said second chamber to a second selected vacuum level.

22. An apparatus according to claim 21, wherein said first vacuum pump and said second vacuum pump each comprise an oil-free vacuum pump.

23. An apparatus according to claim 22, said oil-free vacuum pump selected from the group consisting of oil-free diaphragm pumps, molecular drag pumps, turbomolecular drag pumps, molecular drag pumps backed by a diaphragm pump, turbomolecular drag pumps backed by a diaphragm pump, cryosorption pumps, reciprocating piston pumps, scroll pumps, screw pumps, claw pumps, non-oil sealed single and multistage piston pumps, and rotary lobe (Roots) pumps.

24. An apparatus according to claim 1, further comprising an oil-free vacuum pump for controlling said vacuum conditions.

25. An apparatus according to claim 25, said oil-free vacuum pump selected from the group consisting of oil-free diaphragm pumps, molecular drag pumps, turbomolecular drag pumps, molecular drag pumps backed by a diaphragm pump, turbomolecular drag pumps backed by a diaphragm pump, cryosorption pumps, reciprocating piston pumps, scroll pumps, screw pumps, claw pumps, non-oil sealed single and multistage piston pumps, and rotary lobe (Roots) pumps.

26. An apparatus according to claim 2, further comprising a specimen stage for holding said specimen, said specimen stage being adapted to tilt said specimen with respect to said means for removing, said specimen stage being rotable about an axis of rotation generally perpendicular to a plane defined by a surface of said specimen when said specimen is held by said specimen stage.

27. An apparatus according to claim 26, further comprising means for cooling said specimen stage.

28. An apparatus according to claim 26, said specimen stage being selectively moveable along said axis of rotation.

29. An apparatus according to claim 8, said second chamber further comprising a specimen stage for holding said specimen, said specimen stage being adapted to tilt said specimen with respect to said means for removing, said specimen stage being rotable about an axis of rotation generally perpendicular to a plane defined by a surface of said specimen when said specimen is held by said specimen stage.

30. An apparatus according to claim 8, said second chamber further comprising a cold trap.

31. An apparatus according to claim 8, said second chamber further comprising a crystal oscillator for measuring an amount of said conductive material that is deposited on said specimen.

32. An apparatus for preparing a specimen for microscopy, comprising:

a plasma generator for plasma cleaning said specimen; and

means for removing material from said specimen;

wherein said plasma cleaning of said specimen and said removing of

material from said specimen may be performed under continuous vacuum conditions.

33. An apparatus according to claim 32, wherein said means for removing comprises means for etching said specimen using an ion beam.

34. An apparatus according to claim 33, wherein said means for etching comprises an ion source for directing said ion beam at said specimen.

35. An apparatus according to claim 34, wherein said means for etching further comprises a source of process gas positioned adjacent said ion source.

36. An apparatus according to claim 32, further comprising a first chamber and a second chamber, said first chamber being connected to said second chamber through a vacuum valve, wherein an inside of said first chamber may be exposed to an inside of said second chamber under continuous vacuum conditions by opening said vacuum valve.

37. An apparatus according to claim 36, said plasma generator being supported by said first chamber, said plasma cleaning of said specimen being performed inside said first chamber, and said means for removing being supported by said second chamber, said removing of material from said specimen being performed inside said second chamber.

38. An apparatus according to claim 36, further comprising a transfer rod for supporting said specimen and transferring said specimen between said first chamber and said

second chamber under continuous vacuum conditions.

39. An apparatus according to claim 32, further comprising a vacuum chamber, said vacuum chamber supporting said plasma generator and said means for removing, said plasma cleaning of said specimen and said removing of material from said specimen being performed inside said vacuum chamber.

40. An apparatus according to claim 32, wherein said plasma generator comprises a plasma tube, a coil wrapped around said plasma tube, and an RF power supply connected to said coil.

41. An apparatus according to claim 40, further comprising a source of process gas including oxygen connected to said plasma tube, said plasma cleaning being performed with said process gas.

42. An apparatus according to claim 41, said process gas further including argon.

43. An apparatus according to claim 42, said process gas comprising a mixture of 75% argon and 25% oxygen.

44. An apparatus according to claim 41, said process gas further including a non-reactive gas.

45. An apparatus according to claim 36, further comprising a first vacuum pump connected to said first chamber for evacuating said first chamber to a first selected vacuum level and a second vacuum pump connected to said second chamber for evacuating said second chamber to a second selected vacuum level.

46. An apparatus according to claim 45, wherein said first vacuum pump and said second vacuum pump each comprise an oil-free vacuum pump.

47. An apparatus according to claim 46, said oil-free vacuum pump selected from the group consisting of oil-free diaphragm pumps, molecular drag pumps, turbomolecular drag pumps, molecular drag pumps backed by a diaphragm pump, turbomolecular drag pumps backed by a diaphragm pump, cryosorption pumps, reciprocating piston pumps, scroll pumps, screw pumps, claw pumps, non-oil sealed single and multistage piston pumps, and rotary lobe (Roots) pumps.

48. An apparatus according to claim 32, further comprising an oil-free vacuum pump for controlling said vacuum conditions.

49. An apparatus according to claim 48, said oil-free vacuum pump selected from the group consisting of oil-free diaphragm pumps, molecular drag pumps, turbomolecular drag pumps, molecular drag pumps backed by a diaphragm pump, turbomolecular drag pumps backed by a diaphragm pump, cryosorption pumps, reciprocating piston pumps, scroll pumps, screw pumps, claw pumps, non-oil sealed single and multistage piston pumps, and rotary lobe (Roots)

pumps.

50. An apparatus according to claim 32, further comprising a specimen stage for holding said specimen, said specimen stage being adapted to tilt said specimen with respect to said means for removing, said specimen stage being rotable about an axis of rotation generally perpendicular to a plane defined by a surface of said specimen when said specimen is held by said specimen stage.

51. An apparatus according to claim 50, further comprising means for cooling said specimen stage.

52. An apparatus according to claim 50, said specimen stage being selectively moveable along said axis of rotation.

53. An apparatus according to claim 36, said second chamber further comprising a specimen stage for holding said specimen, said specimen stage being adapted to tilt said specimen with respect to said means for removing, said specimen stage being rotable about an axis of rotation generally perpendicular to a plane defined by a surface of said specimen when said specimen is held by said specimen stage.

54. An apparatus according to claim 36, said second chamber further comprising a cold trap.

55. An apparatus for preparing a specimen for microscopy, comprising:

means for coating said specimen with a conductive material; and

means for plasma etching said specimen;

wherein said coating of said specimen and said plasma etching of said specimen may be performed under continuous vacuum conditions.

56. An apparatus according to claim 55, further comprising an oil-free vacuum pump for controlling said vacuum conditions.

57. An apparatus according to claim 56, said oil-free vacuum pump selected from the group consisting of oil-free diaphragm pumps, molecular drag pumps, turbomolecular drag pumps, molecular drag pumps backed by a diaphragm pump, turbomolecular drag pumps backed by a diaphragm pump, cryosorption pumps, reciprocating piston pumps, scroll pumps, screw pumps, claw pumps, non-oil sealed single and multistage piston pumps, and rotary lobe (Roots) pumps.

58. An apparatus according to claim 55, said plasma etching further comprising capacitive discharge plasma etching.

59. An apparatus according to claim 58, said apparatus further comprising a vacuum chamber, said means for plasma etching comprising a first electrode supported by said vacuum chamber and a second electrode supported by said vacuum chamber, said first and second

electrodes defining a gap therebetween for receiving said specimen.

60. An apparatus according to claim 59, said first and second electrodes each comprising a substantially planar electrode, said first electrode and said second electrode being substantially parallel to one another.

61. An apparatus according to claim 60, further comprising a specimen stage for holding said specimen, said specimen stage being supported by said vacuum chamber, at least a portion of said specimen stage being said first electrode.

62. An apparatus according to claim 61, said specimen stage being moveable in a direction substantially perpendicular to a planar surface of said first electrode.

63. An apparatus according to claim 61, said second electrode being moveable in a direction substantially perpendicular to a planar surface of said second electrode.

64. An apparatus according to claim 59, further comprising an alternating voltage source connected to said first and second electrodes for generating an electric field within said gap, said electric field generating a plasma from a gas introduced into said gap.

65. An apparatus according to claim 55, said plasma etching further comprising inductively coupled plasma etching.

66. An apparatus according to claim 55, said means for coating comprising a magnetron sputtering device.

67. An apparatus according to claim 55, said means for coating comprising an ion source for directing an ion beam at a target, said target being formed of said conductive material.

68. An apparatus according to claim 55, further comprising means for ion beam etching said specimen, wherein said ion beam etching may be performed under said continuous vacuum conditions.

69. An apparatus according to claim 55, further comprising an ion source for directing an ion beam at said specimen, said ion beam etching said specimen, wherein said etching of said specimen with said ion beam may be performed under continuous vacuum conditions.

70. An apparatus according to claim 55, further comprising a vacuum chamber, said vacuum chamber supporting said means for coating and said means for plasma etching, said coating of said specimen and said plasma etching of said specimen being performed inside said vacuum chamber.

71. An apparatus according to claim 68, further comprising a vacuum chamber, said vacuum chamber supporting said means for coating, said means for plasma etching, and said means for ion beam etching, said coating of said specimen, said plasma etching of said specimen

and said ion beam etching of said specimen being performed inside said vacuum chamber.

72. An apparatus according to claim 69, further comprising a vacuum chamber, said vacuum chamber supporting said means for coating, said means for plasma etching, and said ion source, said coating of said specimen, said plasma etching of said specimen and said ion beam etching of said specimen being performed inside said vacuum chamber.

73. An apparatus according to claim 67, wherein said ion source may selectively direct said ion beam at said specimen for ion beam etching said specimen under said continuous vacuum conditions.

74. An apparatus according to claim 73, further comprising a specimen stage for holding said specimen, said specimen stage being moveable between a first position in which said specimen is within a path of said ion beam such that said ion beam is directed at and impinges upon said specimen and a second position in which said specimen is outside of said path such that said ion beam is directed at and impinges upon said target.

75. An apparatus according to claim 74, said specimen stage being adapted to tilt said specimen with respect to said ion source, said specimen stage being rotable about an axis of rotation generally perpendicular to a plane defined by a surface at said specimen when said specimen is held by said specimen stage.

76. An apparatus according to claim 55, further comprising a plasma generator for plasma cleaning said specimen, wherein said plasma cleaning may be performed under said continuous vacuum conditions.

77. An apparatus according to claim 76, wherein said plasma generator comprises a plasma tube, a coil wrapped around said plasma tube, and an RF power supply connected to said coil.

78. An apparatus according to claim 77, further comprising a source of process gas including oxygen connected to said plasma tube, said plasma cleaning being performed with said process gas.

79. An apparatus according to claim 78, said process gas further including argon.

80. An apparatus according to claim 79, said process gas comprising a mixture of 75% argon and 25% oxygen.

81. An apparatus according to claim 78, said process gas further including a non-reactive gas.

82. An apparatus according to claim 68, further comprising a plasma generator for plasma cleaning said specimen, wherein said plasma cleaning may be performed under said

continuous vacuum conditions.

83. An apparatus according to claim 82, wherein said plasma generator comprises a plasma tube, a coil wrapped around said plasma tube, and an RF power supply connected to said coil.

84. An apparatus according to claim 83, further comprising a source of process gas including oxygen connected to said plasma tube, said plasma cleaning being performed using said process gas.

85. An apparatus according to claim 84, said process gas further including argon.

86. An apparatus according to claim 85, said process gas comprising a mixture of 75% argon and 25% oxygen.

87. An apparatus according to claim 84, said process gas further including a non-reactive gas.

88. An apparatus according to claim 76, further comprising a vacuum chamber, said vacuum chamber supporting said means for coating, said means for plasma etching and said plasma generator, said coating of said specimen, said plasma etching of said specimen and said plasma cleaning of said specimen being performed inside said vacuum chamber.

89. An apparatus according to claim 82, further comprising a vacuum chamber, said vacuum chamber supporting said means for coating, said means for plasma etching, said plasma generator, and said means for ion beam etching, said coating of said specimen, said plasma etching of said specimen, plasma cleaning of said specimen and said ion beam etching of said specimen being performed inside said vacuum chamber.

90. An apparatus for preparing a specimen for microscopy, comprising:

a first vacuum chamber;

a second vacuum chamber connected to said first vacuum chamber;

a specimen stage moveable between a first position and a second position under continuous vacuum conditions, said first position being inside said first vacuum chamber and said second position being inside said second vacuum chamber;

means for coating said specimen with a conductive material, said means for coating being supported by said first vacuum chamber;

means for plasma etching said specimen, at least a portion of said means for plasma etching being supported by said second vacuum chamber.

91. An apparatus according to claim 90, further comprising a first oil-free vacuum pump connected to said first vacuum chamber and a second oil-free vacuum pump connected to said second vacuum chamber.

92. An apparatus according to claim 91, said first and second oil-free vacuum pumps selected from the group consisting of oil-free diaphragm pumps, molecular drag pumps,

turbomolecular drag pumps, molecular drag pumps backed by a diaphragm pump, turbomolecular drag pumps backed by a diaphragm pump, cryosorption pumps, reciprocating piston pumps, scroll pumps, screw pumps, claw pumps, non-oil sealed single and multistage piston pumps, and rotary lobe (Roots) pumps.

93. An apparatus according to claim 90, said plasma etching further comprising capacitive discharge plasma etching.

94. An apparatus according to claim 93, said means for plasma etching comprising a first electrode supported by said second chamber and a second electrode, at least a portion of said specimen stage being said second electrode, said first and second electrodes defining a gap therebetween when said specimen stage is in said second position.

95. An apparatus according to claim 94, said first and second electrodes each comprising a substantially planar electrode, said first electrode and said second electrode being substantially parallel to one another.

96. An apparatus according to claim 94, further comprising an alternating voltage source connected to said first and second electrodes for generating an electric field within said gap, said electric field generating a plasma from a gas introduced into said gap.

97. An apparatus according to claim 94, said specimen stage being moveable in a first longitudinal direction between said first position and said second position, said first electrode

being moveable in a second longitudinal direction substantially perpendicular to said first longitudinal direction.

98. An apparatus according to claim 90, said means for coating comprising a magnetron sputtering device.

99. An apparatus according to claim 90, said means for coating comprising an ion source for directing an ion beam at a target, said target being formed of said conductive material.

100. An apparatus according to claim 99, wherein said ion source may selectively direct said ion beam at said specimen for ion beam etching said specimen under said continuous vacuum conditions.

101. An apparatus according to claim 100, said specimen stage being further moveable to a third position, said third position being inside said first vacuum chamber, said specimen being within a path of said ion beam in said third position such that said ion beam is directed at and impinges upon said specimen, and said specimen being outside of said path in said first position such that said ion beam is directed at and impinges upon said target.

102. An apparatus according to claim 90, further comprising a plasma generator for plasma cleaning said specimen under said continuous vacuum conditions.

103. An apparatus according to claim 102, said plasma generator being supported by said first vacuum chamber.

104. An apparatus according to claim 102, said plasma generator being supported by said second vacuum chamber.

105. An apparatus according to claim 90, further comprising a valve between said first chamber and said second chamber, said valve having a closed state for isolating said first chamber from said second chamber and an open state for permitting said specimen stage to move between said first position and said second position.

106. An apparatus according to claim 105, said valve in said open state mating with said specimen stage when said specimen stage is in said second position, wherein said mating of said valve and said specimen stage forms a substantial seal against mass transfer between said first vacuum chamber and said second vacuum chamber.

107. An apparatus according to claim 90, further comprising a baffle between said first chamber and said second chamber, said baffle having an open state for permitting said specimen stage to be moved between said first position and said second position.

108. An apparatus for preparing a specimen for microscopy, comprising:

a vacuum chamber;

an ion source connected to said vacuum chamber for

directing an ion beam at said specimen for etching said specimen;

a plasma etching assembly connected to said vacuum chamber for plasma etching said specimen; and

means for coating said specimen with a conductive material, said means for coating being supported by said vacuum chamber;

wherein said etching, said plasma etching and said coating of said specimen may be performed under continuous vacuum conditions established within said vacuum chamber.

109. An apparatus according to claim 108, further comprising a plasma generator connected to said vacuum chamber for plasma cleaning said specimen under said continuous vacuum conditions.

110. An apparatus according to claim 109, wherein said plasma generator comprises a plasma tube, a coil wrapped around said plasma tube, and an RF power supply connected to said coil.

111. An apparatus according to claim 110, further comprising a source of process gas connected to said plasma tube.

112. An apparatus according to claim 111, said process gas including oxygen.

113. An apparatus according to claim 112, said process gas further including argon.

114. An apparatus according to claim 113, said process gas comprising a mixture of 75% argon and 25% oxygen.

115. An apparatus according to claim 112, said process gas further including a non-reactive gas.

116. An apparatus according to claim 108, further comprising an oil-free vacuum pump for establishing said continuous vacuum conditions within said vacuum chamber.

117. An apparatus according to claim 116, said oil-free vacuum pump selected from the group consisting of oil-free diaphragm pumps, molecular drag pumps, turbomolecular drag pumps, molecular drag pumps backed by a diaphragm pump, turbomolecular drag pumps backed by a diaphragm pump, cryosorption pumps, reciprocating piston pumps, scroll pumps, screw pumps, claw pumps, non-oil sealed single and multistage piston pumps, and rotary lobe (Roots) pumps.

118. An apparatus according to claim 108, further comprising a load lock chamber connected to said vacuum chamber.

119. An apparatus according to claim 108, said etching comprising ion beam etching, said apparatus further comprising a source of inert process gas connected to said ion source.

120. An apparatus according to claim 108, said etching comprising reactive ion beam etching, said apparatus further comprising a source of reactive process gas connected to said ion source.

121. An apparatus according to claim 108, said plasma etching utilizing a plasma generated by capacitive discharge, said plasma etching assembly further comprising an electrode and an alternating voltage source connected to said electrode.

122. An apparatus according to claim 121, further comprising a sample stage for holding said specimen, at least a portion of said sample stage comprising a second electrode utilized in said generation of said plasma and said plasma etching.

123. An apparatus according to claim 122, said sample stage being moveable to a position in which a gap is formed between said electrode and said second electrode, said alternating voltage source generating an electric field within said gap, said electric field generating a plasma from a gas introduced into said gap.

124. An apparatus according to claim 123, wherein one or more of a size of said gap and a power of said alternating voltage source are automatically controlled based on parameters

set by a user.

125. An apparatus according to claim 123, said plasma etching assembly further comprising two or more gas inlets, said process gas comprising a mixture of two or more process gasses selected by a user.

126. An apparatus according to claim 125, wherein said process gasses further comprise at least one of O_2, CF_4 and CHF_3.

127. An apparatus according to claim 108, said plasma etching assembly further comprising two or more gas inlets, said plasma etching of said specimen utilizing a plasma generated from a mixture of two or more process gasses selected by a user.

128. An apparatus according to claim 108, said plasma etching assembly being usable to plasma clean said specimen by generating a plasma from a process gas including oxygen.

129. An apparatus according to claim 108, said coating comprising ion beam sputter coating, said means for coating comprising a target formed of said conductive material, said ion source directing said ion beam at said target.

130. An apparatus according to claim 129, said means for coating further comprising a lever supported by said vacuum chamber, said lever holding said target, said lever being

selectively moveable into a position in which said ion beam is directed at said target.

131. An apparatus according to claim 108, said means for coating comprising a plurality of targets, each of said targets being formed of a conductive material, said ion source directing said ion beam at a selected one of said targets.

132. An apparatus according to claim 131, said means for coating further comprising means for moving said selected one of said targets from a covered position to an exposed position.

133. An apparatus according to claim 131, said means for coating further comprising a lever supported by said vacuum chamber, said lever holding said plurality of targets, said lever being selectively moveable into a position in which said ion beam is directed at said selected one of said targets.

134. An apparatus according to claim 133, said plurality of targets being held by a target holder, said target holder being moveable among a plurality of positions, each of said positions exposing one of said targets and covering a remaining one or more of said targets.

135. An apparatus according to claim 134, said target holder being rotatably supported by said lever, said target holder being rotatable among said plurality of positions.

136. An apparatus according to claim 135, said target holder further comprising a plurality of pins, said vacuum chamber supporting an arm, said target holder being selectively rotated by contact between said arm and any one of said pins.

137. An apparatus according to claim 133, further comprising means for selectively exposing said selected one of said targets and covering a remaining one or more of said targets.

138. An apparatus according to claim 108, further comprising a sample stage for holding said specimen.

139. An apparatus according to claim 138, said sample stage being moveable to a plurality of processing positions inside said vacuum chamber under said continuous vacuum conditions for performing said etching, said plasma etching and said coating of said specimen.

140. An apparatus according to claim 139, said sample stage being automatically moveable among said processing positions based on parameters set by a user.

141. An apparatus according to claim 140, said parameters including an order of movement among selected ones of said processing positions.

142. An apparatus according to claim 139, said sample stage being moveable in a first direction along a vertical axis of said vacuum chamber, said apparatus further comprising means for detecting a first position of a surface of said specimen along said vertical axis, wherein said

sample stage is moved automatically to said plurality of processing positions based on said first position.

143. An apparatus according to claim 142, wherein said first position is measured relative to a second position along said vertical axis.

144. An apparatus according to claim 138, said sample stage being moveable in a first direction along a vertical axis of said vacuum chamber, said apparatus further comprising a beam generating device and a beam sensor supported by said vacuum chamber, said beam generating device and said beam sensor being used to detect a first position of a surface of said specimen along said vertical axis, wherein said sample stage is moved automatically to said plurality of processing positions based on said first position.

145. An apparatus according to claim 144, wherein said first position is measured relative to a second portion along said vertical axis.

146. An apparatus according to claim 144, said beam generating device comprising a laser.

147. An apparatus according to claim 138, said sample stage being moveable in a first direction along a vertical axis of said vacuum chamber, at least a first portion of said sample stage that supports said specimen being rotatable about said vertical axis, and at least a second portion of said sample stage connected to said first portion being moveable in a first angular

direction with respect to said vertical axis.

148. An apparatus according to claim 147, at least a third portion of said sample stage connected to said second portion being moveable in a second angular direction with respect to said vertical axis.

149. An apparatus according to claim 138, said sample stage having at least three degrees of selective independent movement.

150. An apparatus according to claim 149, sample stage having at least four degrees of selective independent movement.

151. An apparatus according to claim 108, said vacuum chamber having a first aperture adjacent said plasma generator, a first moveable shutter for selectively covering said first aperture, a second aperture adjacent said plasma etching assembly, and a second moveable shutter for selectively covering said second aperture.

152. A method for preparing a specimen for microscopy, comprising:

determining a first position of a surface of said specimen along an axis of a processing chamber;

automatically moving said specimen to one or more processing locations within said processing chamber based on said first position.

153. A method according to claim 152, said determining step further comprising determining said first position relative to a second position along said axis.

154. A method according to claim 152, said determining step further comprising:

generating a beam;

directing said beam at a sensor;

moving said specimen along said axis;

establishing said first position when a predetermined level is measured by said sensor.

155. A method according to claim 154, said beam comprising a laser beam.

156. A method according to claim 154, said predetermined level comprising approximately 50% of a level measured when said sensor is completely unobscured.

157. A method according to claim 156, said determining step further comprising:

(a) moving said specimen along said axis to an obscuring position in which said sensor is completely obscured and setting a blocked position variable equal to said obscuring position;

(b) moving said specimen along said axis to an unobscuring position in which said sensor is completely unobscured, obtaining an unobscured sensor level reading, and setting a clear position variable equal to said unobscuring position;

(c) moving said specimen to a midpoint position that is approximately

halfway between a position equal to said blocked position variable and a position equal to said clear position variable;

(d) obtaining a current sensor level reading at said midpoint position;

(e) determining whether said current sensor level reading is equal to approximately 50% of said unobscured sensor level reading;

(f) setting said first position equal to said midpoint position if said current sensor level reading is equal to approximately 50% of said unobscured sensor level reading;

(g) setting said blocked position variable equal to said midpoint position if said current sensor level reading is less than approximately 50% of said unobscured sensor level reading and repeating steps (c) through (h) until said first position is set in step (f); and

(h) setting said clear position variable equal to said midpoint position if said current sensor level reading is greater than approximately 50% of said unobscured sensor level reading and repeating steps (c) through (h) until said first position is set in step (f).

158. An apparatus for preparing a specimen for microscopy, comprising:

a processing chamber;

a sample stage, said sample stage being moveable to one or more processing positions inside said processing chamber; and

means for detecting a first position of a surface of said specimen along an axis of said processing chamber;

wherein said sample stage is moved automatically to said one or more

processing positions based on said first position.

159. An apparatus according to claim 158, wherein said first position is measured relative to a second position along said axis.

160. An apparatus according to claim 158, said processing positions including positions for performing one or more of etching said specimen, plasma cleaning said specimen, plasma etching said specimen and coating said specimen with a conductive material.

161. An apparatus for preparing a specimen for microscopy, comprising:

a processing chamber;

a sample stage, said sample stage being moveable to one or more processing positions inside said processing chamber; and

a beam generating device and a beam sensor supported by said processing chamber, said beam generating device and said beam sensor being used to detect a first position of a surface of said specimen along an axis of said processing chamber;

wherein said sample stage is moved automatically to said one or more processing positions based on said first position.

162. An apparatus according to claim 161, wherein said first position is measured relative to a second position along said axis.

163. An apparatus according to claim 161, said processing positions including positions for performing one or more of etching said specimen, plasma cleaning said specimen, plasma etching said specimen and coating said specimen with a conductive material.

164. An apparatus according to claim 161, said beam generating device comprising a laser.